RANGE IMPROVEMENT

NOTES

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STATEMENT OF PUBLICATION

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This publication is printed primarily to inform professional range administrators of important range improvement and management developments and findings. These "NOTES" may include extracts of published papers, unpublished preliminary reports of research work, unpublished reports on administrative studies and personal observations or suggestions of other range administrators. No claim is made as to the accuracy or completeness of studies or conclusions drawn.

All who read these RANGE IMPROVEMENT NOTES are encouraged to submit material for publication, or suggestions for improving its usefulness. Full credit will be given for any material used.

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Lead Springs Hydraulic Ram Project - 1969

By

Rodman N. Barker* and Joseph Kinsella**

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Bridger National Forest personnel solved a water shortage problem on the Beaver Horse Demonstration Allotment in a rather unique way. Dry Beaver Creek is completely dry during the grazing season while the adjacent drainage, Lead Creek, has a large spring. One drainage has the feed and the other the water. The problem was how to get the water over a 160-foot ridge into Dry Beaver; which problem was solved by installing a hydraulic ram below Lead Springs and piping the water over the ridge.

A ram has many advantages for rangeland installation because it needs neither electricity nor gasoline to function. Also, it is a relatively simple device which needs little maintenance. Therefore, it lends itself well to remote installations. Basically, a hydraulic ram is a water pump which is operated by water power. The force of a large volume of water, flowing downhill through a pipe to the ram, is used to pump a small volume of water uphill for a great distance.

The actual operation of the ram is more technically described as follows: Water is conducted to the ram through a steeply inclined drive pipe. The velocity and pressure developed by the water flowing down this drive pipe is used to operate the ram. Water entering the ram is allowed to escape through an outside valve until a certain velocity is reached. At this velocity, pressure causes the outside valve to close quickly and the inside valve to open, so that the full head of water is diverted into the dome-shaped air chamber and out the delivery pipe. The air cushion within the dome builds up pressure and causes a rebound action of the water which closes the inside valve and allows the outside valve to open again. With the opening of the outside valve, water once more bypasses the ram until it builds up enough velocity and pressure to repeat the process. This cycle is repeated 25 to 75 times per minute, and with each surge, a small amount of water is forced up the delivery pipe.

There seems to be two problems common to most ram installations. The first is finding a water source which will provide enough water to make the project feasible, since only ten to twenty percent of the water passing through the ram is actually pumped to the new location. The second problem is usually locating a site where sufficient fall can be obtained to drive the ram. Wherever an adequate water supply is available and arrangements can be made to get a fall or drop in this water for power, a ram can be used.

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The ram itself will operate under a wide range of power, and delivery heads from about 1 to 4 up to about 1 to 30. An example of this is that water power from a 10-foot fall will pump water 40 to 300 vertical feet. However, the higher the life (delivery head), the less water pumped per hour. If a ram is pumping 10 gallons per minute 100 vertical feet, then it may only pump 5 gallons per minute 200 vertical feet. The more fall from the water supply to the ram (power head), the more water it will pump. Generally, it pays to get all the fall you can, not to exceed 50 feet.

Lead Springs, the water source for the ram, flows in excess of 100 gallons per minute and lies on a steep sixty-percent slope. Neither water source nor fall were a problem, so design criteria focused on the amount of water required on Dry Beaver, rather than what was available at Lead Springs.

We needed about 3000 gallons per day to have a reserve for all the livestock in Dry Beaver during peak grazing periods. We allowed an extra buffer for mistakes and settled on 4000 gallons per day as a requirement. Rife engineers, manufacturers of the ram, advised us that a 2-in. heavy duty ram using 140 feet of drive pipe and set 35 feet below the springs could deliver in excess of 4300 gallons per day over the necessary 160-foot lift.

The ram was installed during the 1970 field season. Some changes were necessary in the original design due to undesirable terrain features. A large head box had to be constructed to divert water from the turbulent stream so air bubbles would be able to escape. The drive pipe had to be increased to 155 feet to provide a suitable location for the ram. These changes increased the fall to nearly 45 feet, so that the ram acquired more drive power. Finally, a new route was chosen for the delivery pipe to maintain a 160-foot vertical lift even though the ram was 15 feet lower than the original design.

The final result of all these changes is that the ram delivers about 7200 gallons of water per day into the Dry Beaver drainage.

Costs for this installation are competitive with windmills and other water pumping devices. The ram complete with shutoff valves cost about $500; pipe and fixtures cost an additional $400. Labor installation costs ran about $2000 due to the difficulty of working on the steep terrain. Multiple use considerations, which required not only protection of the site, but also dressing up the finished project, added an additional 25 percent to the cost. We believe the additional cost was well justified since the completed installation is scarcely noticeable and Lead Springs remains quite a scenic spot.

Plans for the 1971 field season call for installation of three miles of plastic delivery pipe, storage tanks, and four water developments.

Admittedly, Lead Springs is an ideal situation for a ram installation, but many other less desirable locations can be made suitable for a hydraulic ram installation with just a little ingenuity.

Fig. 1 - Four-inch transfer pipe directs water from spring to collection box.

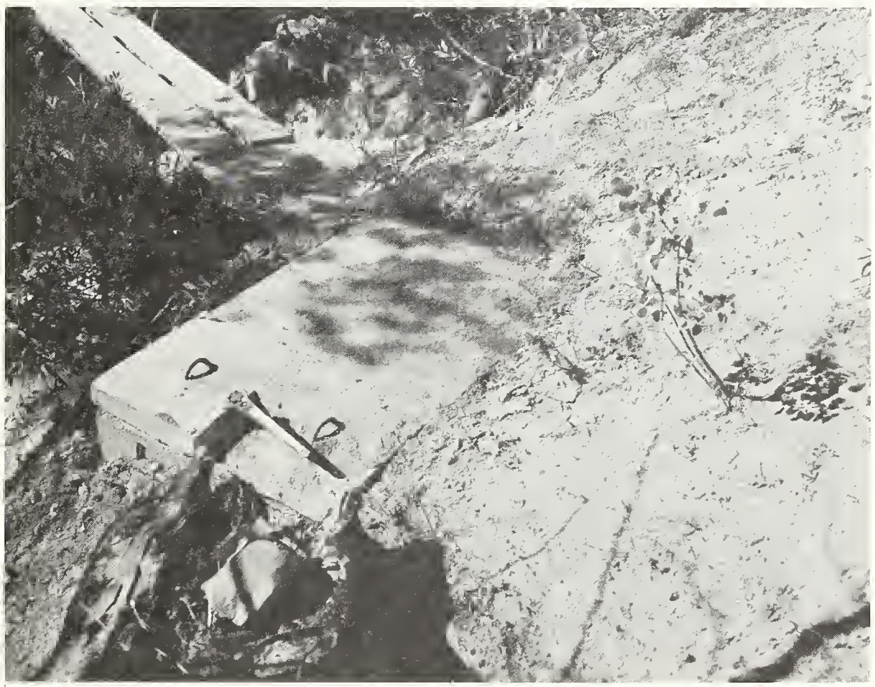


Fig. 2 - From collection box water enters two-inch drive pipe and travels to ram.

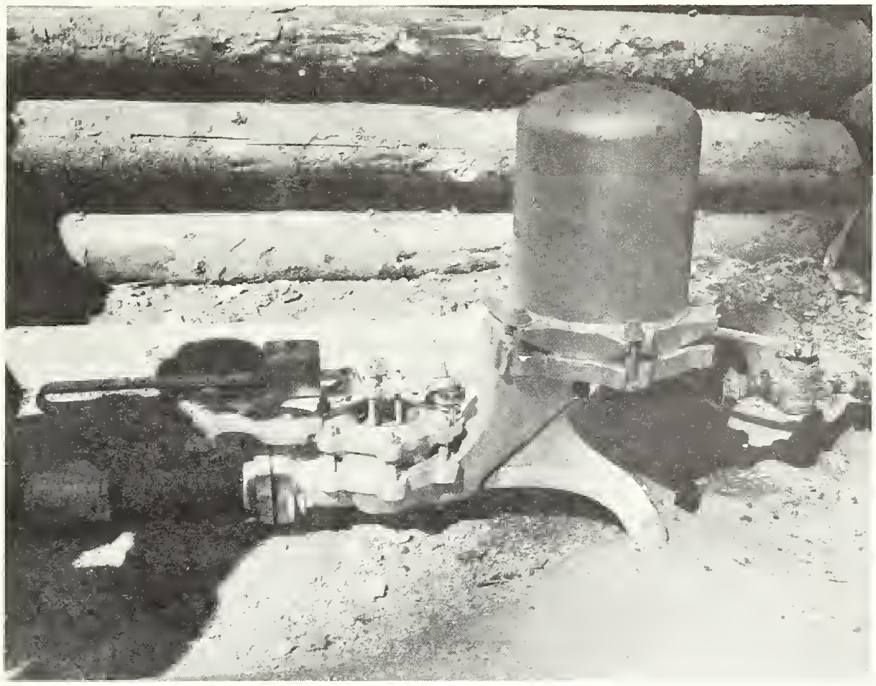


Fig. 3 - Closeup of Rife two-inch Hydraulic Ram.

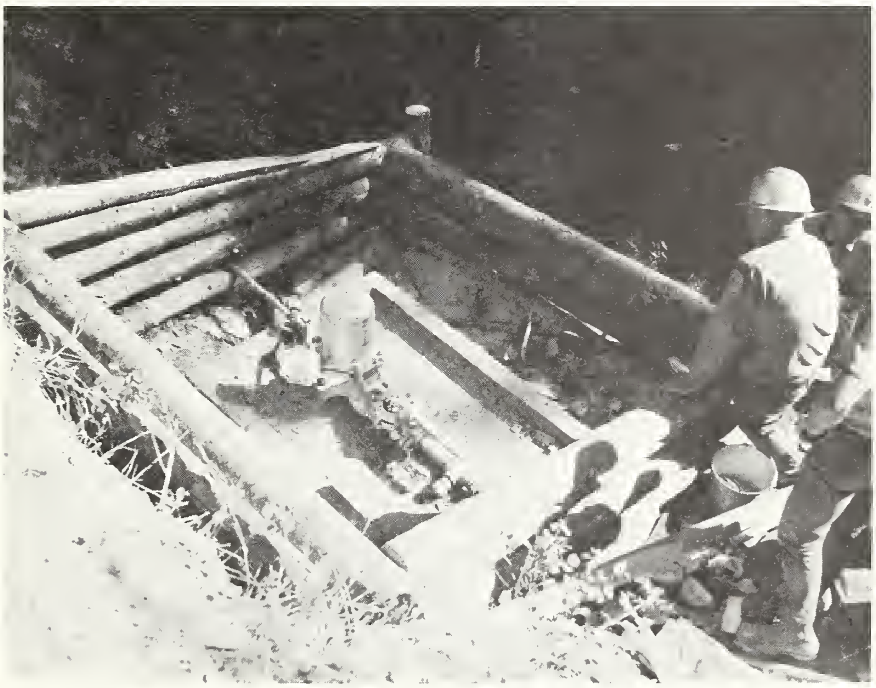


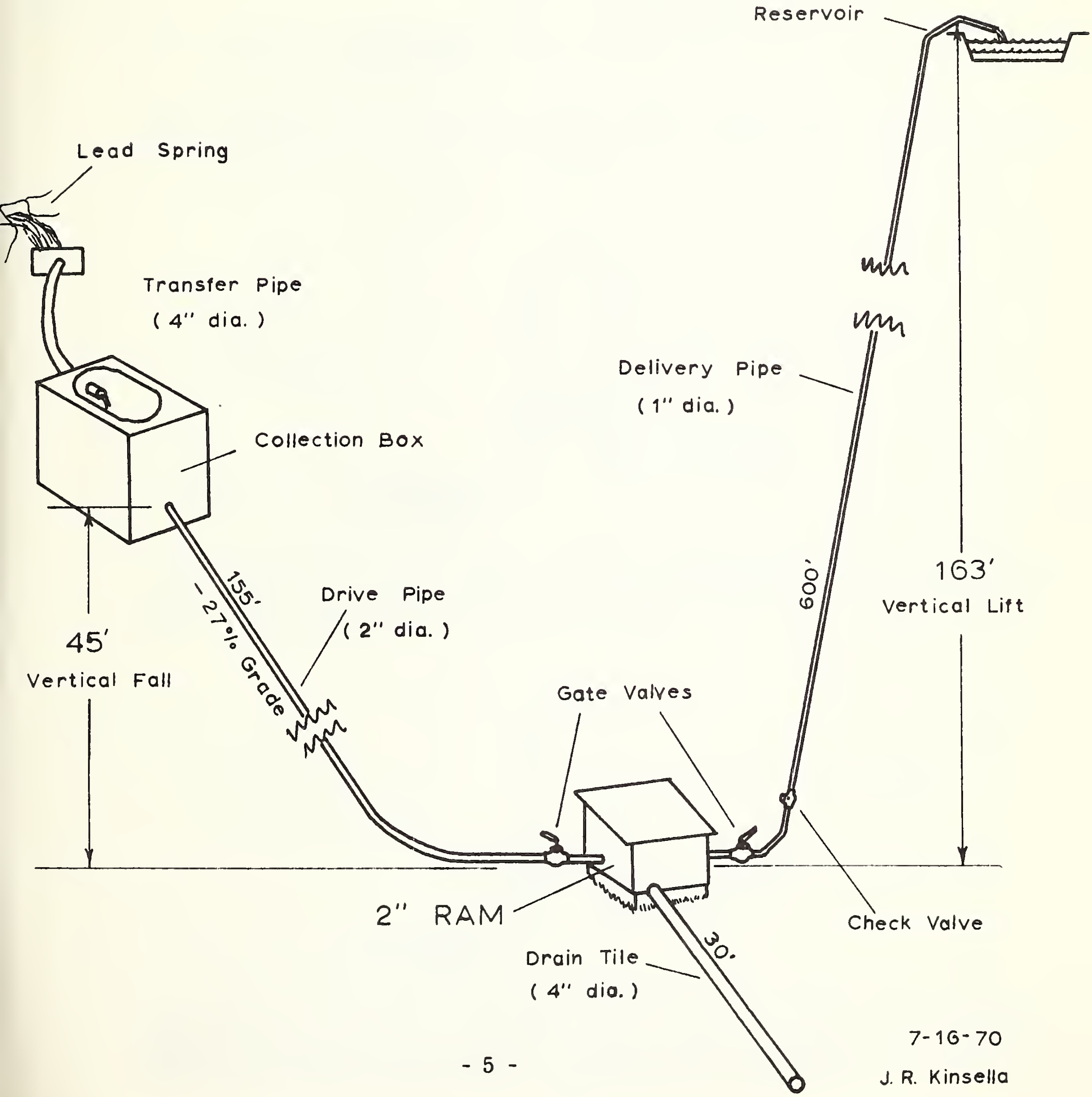
Fig. 4 - Protective crib before roof was constructed. Note four-inch drain tile in concrete base.

LEAD CREEK

HYDRAULIC RAM INSTALLATION

Bridger National Forest

Region 4



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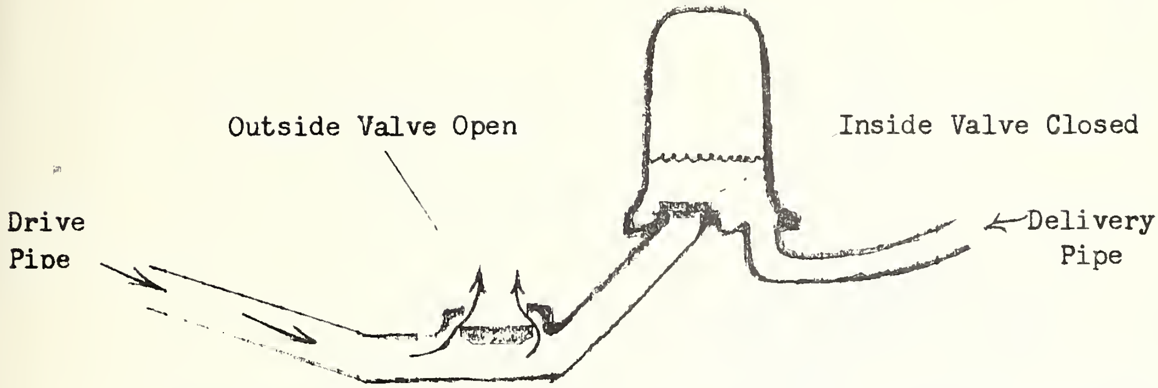
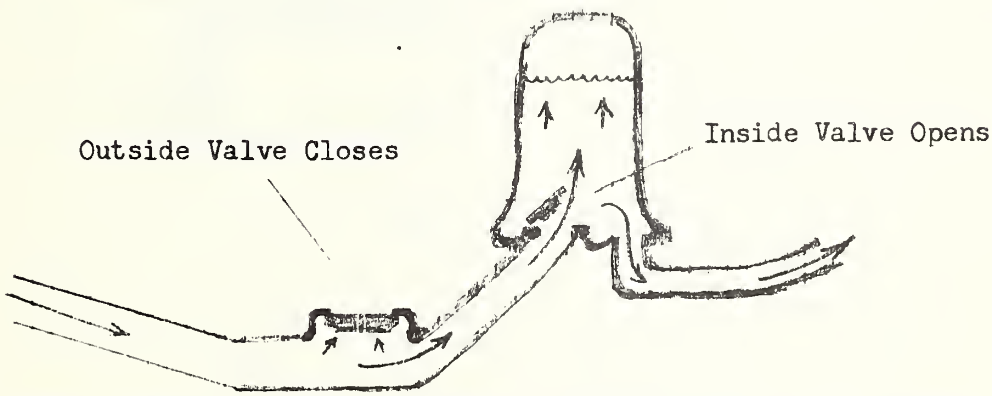
J. R. Kinsella

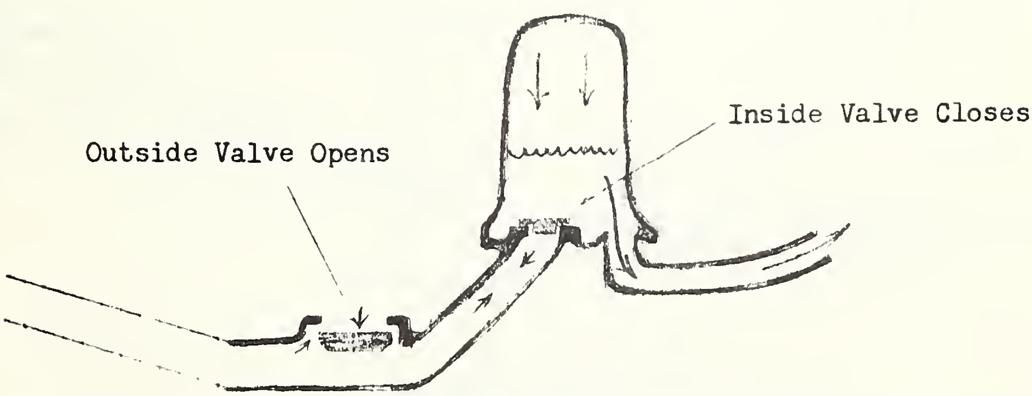
Graphic Explanation
of
Hydraulic Ram Operation



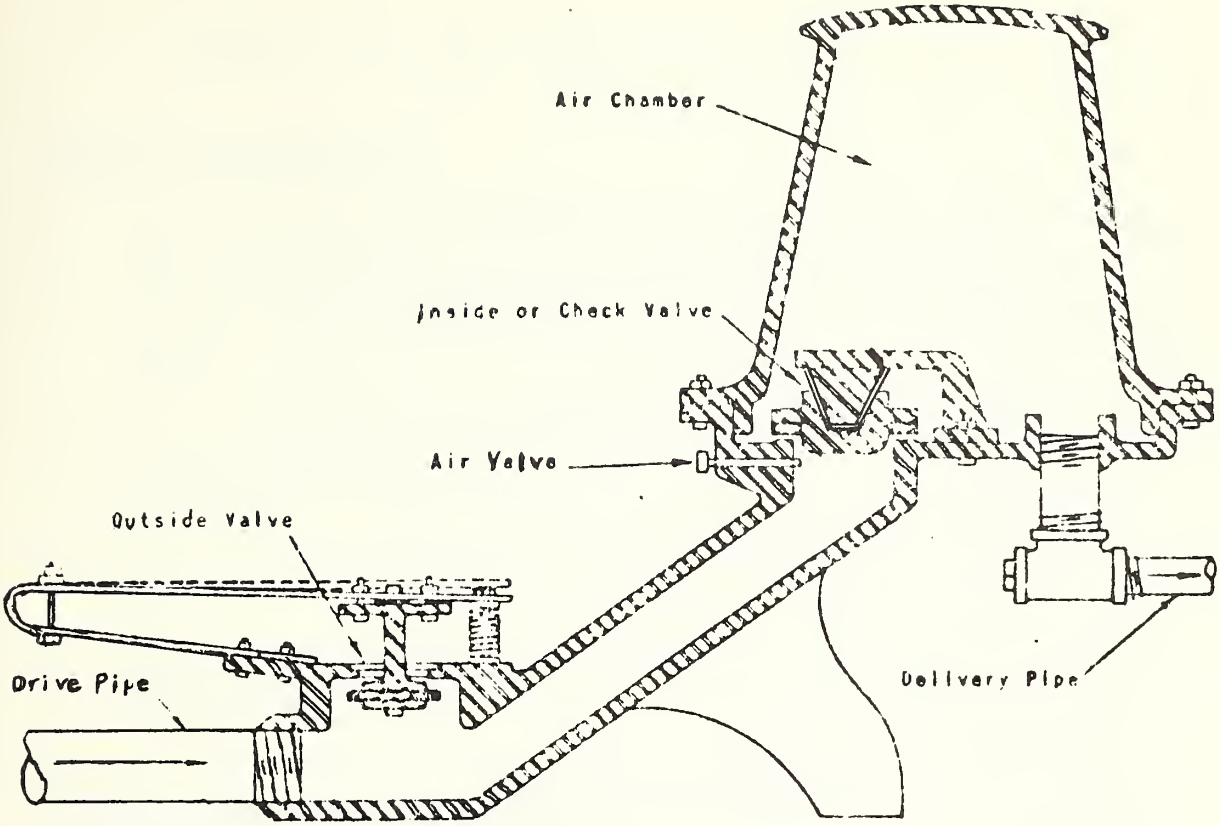
Water flows down drive pipe into Ram. Water escapes through outside valve while building up velocity and pressure.



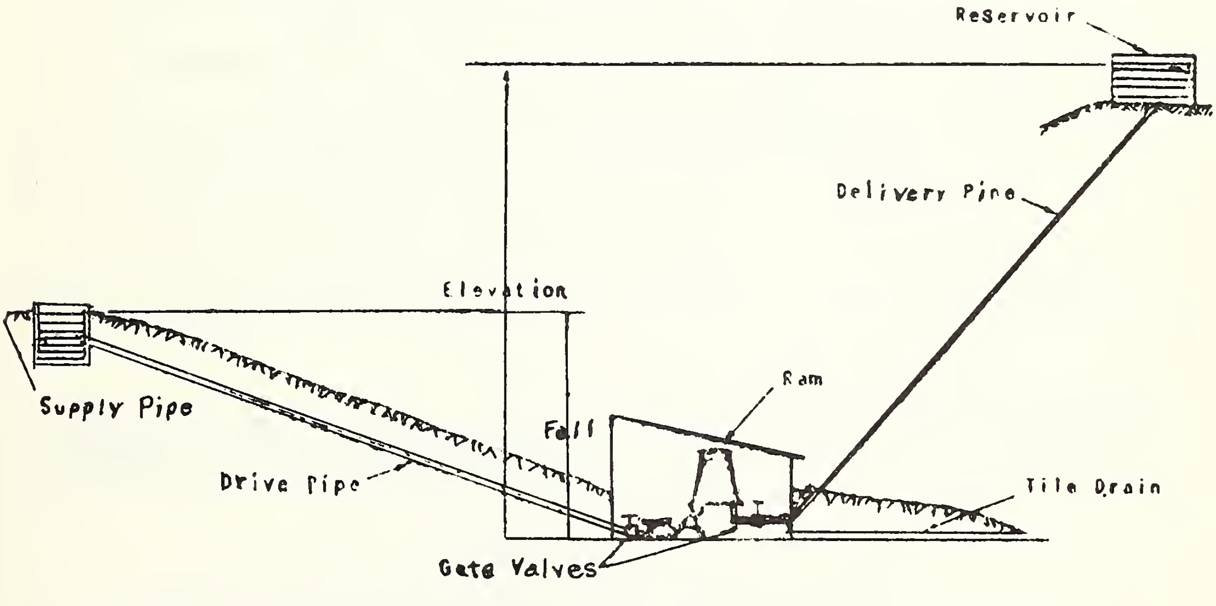
Water velocity increases enough to snap outside valve closed. Inside valve is forced open and water surges into air dome compressing air at top of dome. Some water pushed out delivery pipe.



Compressed Air at top of dome causes rebound action which closes inside valve and pushes water up delivery pipe. Water in drive pipe is at zero velocity so outside valve drops open and cycle is repeated.



Diagrammatic sketch of ram



Typical ram installation

Design Criteria for Ram Installations

Location Requirements

1. The ram must be located below the water source. The minimum fall required is 20 inches while the maximum usable fall is about 50 feet. Good installations will pump to a vertical height of 25 feet for each foot of fall but not higher than 500 feet for even the best rams.

2. The length of drive pipe varies from about 30 feet to 150 feet depending upon the fall.

3. Installation must be made so waste water will flow away from the ram.

4. Water supply must produce at least 1-1/2 gallons per minute for minimum operation.

Information required for Prospective Installation

1. Available supply of water in gallons per minute.

2. Vertical fall in feet from water source to ram site.

3. Slope distance from water source to ram site.

4. Vertical distance from ram site to point of delivery.

5. Length of delivery pipe required.

6. Volume of water output required at point of delivery in gallons per day.

Formula for Calculating the Number of Gallons that Will be Delivered Per Hour to a Given Point by Ram.

$$\frac{V \times F}{E} \times \frac{6}{10} = D$$

V = Volume of water available in gallons per minute.
F = Vertical fall in feet from water source to ram.
E = Vertical elevation in feet that the water is to be raised
$\frac{6}{10}$ = 60%, the normal efficiency of a ram installation.
D = Gallons delivered in gallons per minute.

Each ram manufacturer has a chart for different size rams that shows the expected performance for any given installation. While additional information will be needed to determine the size of ram needed for any given setup, the following table does give an indication of the capacity of these pumps.

Intake Capacities for Various Size Rams

Pipe Size in Inches		Intake Capacity (In Gallons Per Minute)	
Drive	Delivery	Minimum	Maximum
1-1/4	3/4	1.5	12
1-1/2	3/4	6	18
2	1	8	35
2-1/2	1	12	45
3	1-1/4	20	85
4	2	35	150
6	3	75	400

The delivery from rams will vary from about 20% of intake capacity down to less than 5% depending on the fall and vertical lift required.

Installation

A collection box is usually needed to provide a constant supply and uniform head. Water entering the drive pipe should be clean and free of air bubbles.

The drive pipe carries water from the intake to the ram. This should be steel pipe and as straight as possible with no joint turns. Five foot radius bent turns are acceptable. The drive pipe should be buried to prevent movement.

The correct length of this drive pipe is important for efficient ram operation. For vertical fall up to 15 feet, the drive pipe length should be about six times the vertical fall; for 25 feet, about four times the fall; and for 50 feet vertical fall, about three times the fall in length. The drive pipe should be the same diameter as the intake size of the ram.

The ram itself should be mounted on a concrete foundation that slopes toward a drain. Provision should be made to drain the waste water away from the ram.

The delivery pipe leading from the ram should be at least one-half the diameter of the drive pipe and also be free of sharp bends.

Miscellaneous

Rams can work from any water source as long as it is reasonably clean. Artesian wells are an excellent source. A ram will also provide pressure for pressure tanks or elevated storage tanks.

In cases where adequate fall cannot be obtained near the water source, it may be possible to divert the water away from the source, by either a ditch or a pipe, to where more fall can be obtained.

Following is a list of companies who manufacture hydraulic rams. Catalogues and additional information may be obtained from them.

Rife Hydraulic Engine Manufacturing Co.
Box 367
Millburn, New Jersey 07041

The SKOOKUM Co., Inc.
8524 N. Crawford
Portland, Oregon 97203

Paul Edwards ("Hill" Hydraulic Rams)
844 South 154th Place
Seattle, Washington 98148

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NEAR accidents are WARNINGS ! !

NEAR accident TODAY --

BAD accident TOMORROW. . . .

MARKER DYE FOR SAGEBRUSH SPRAY
By
J. R. Kinsella*

Many sagebrush spray projects are not well adapted to aerial application. This is because areas to be sprayed are small or adjacent to willow stands. The Bridger National Forest has many small patches of sagebrush which can be effectively treated by ground-rig sprayers.

However, one of the problems of ground-rig spraying is that it is difficult for the operator to see his last sprayed strip--especially in rolling terrain or along crooked routes. In the past, we used ground guides who ran along the edge of the previously sprayed strip and pointed out the way for the spray rig operator. This method works, but it is expensive, and hard on guids who either become track stars or faint somewhere along the way.

The obvious solution, of course, was to put something in the herbicide to make it visible to the sprayer operator. Many dyes have been tried in sagebrush spray herbicides with no success. The basic problem is that dyes tend to precipitate out and clog spray nozzles.

We, too, tried several powder type sprays which required premixing and found them to be unsatisfactory for various reasons

Finally, we started working with the DuPont Rhodamine series dyes and found several which would work. The cheapest dye, "DuPont Paper Blue R Solution," appeared to meet most of our criteria but was difficult to see as it blended in with sagebrush.

We finally settled on "DuPont Rhodamine B Solution." This is a weak acetic acid solution of dye concentrate. The color is a brilliant violet which flouresces brightly in sunlight. This dye readily mixes with the 2, 4-D and water carrier. We found that for some reason or other, it is better to pour 2, 4-D into the water, mix it up and then add the dye. If the dye is added first, then the 2, 4-D has a slight tendency to settle out.

We use about one pint per 200 gallons of spray. This gives just enough color with a boom type sprayer so the operator can see the previously sprayed strip. Rainstorms have no effect on the dyed sagebrush, but sunlight will destroy the color in several weeks.

This DuPont costs about $2.18 per pound, so it should be measured out judiciously; but in actual field tests, it is tremendously economical compared with the cost of an extra man. This is because the dye is a fixed cost per load, while the man is paid rain or shine, breakdown or work.

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We believe this dye holds the obvious solution for the drawbacks of ground-rig spraying in sagebrush. It is easy to use, is not dangerous nor toxic, and even an amateur can follow violet spray strips with very little training.

The next step will be to search out a water soluble food dye that will obtain the same results for less cost. We would appreciate hearing from anyone who knows of a cheap dye in the orange to purple spectrum that we can test.

DuPont Rhodamine B Solution may be purchased from:

E. I. DUPONT DE NEMOURS & COMPANY
Organic Chemicals Department
Dyes and Chemicals Division
701 Welch Road
Palo Alto, California 94304

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Abe Lincoln said--

A woman's dress is like a speech--
It should be SHORT enough to be INTERESTING,
but LONG enough to COVER the subject.

Modern day application--

A dress should be TIGHT enough
to show there's a woman inside of it--
but LOOSE enough
to show that she's a LADY.

THE DUDE RANCHER-Summer 1969